10.0 CONCLUSIONS

The following conclusions are based on the analysis of the pre-EMS and post-EMS surveys; the corporate EMS survey; the pre-EMS and post-EMS profiles; and a response to an additional information request that Tetra Tech submitted to UTC facilities.

- The primary root cause of noncompliance identified in the pre-EMS surveys was the lack of a formal management structure for addressing regulatory compliance issues. Representatives of UTC who completed the surveys indicated that the primary root cause of noncompliance identified in the pre-EMS surveys was the lack of a formal management structure for addressing regulatory compliance issues and that the primary root cause of noncompliance in the post-EMS period was individuals not following established procedures, differences in interpretations of regulations by UTC facilities and regulatory agencies, or facilities being unaware of the applicability of new regulations.

- Regulatory compliance improved at the UTC facilities that responded with respect to RCRA and CWA noncompliance identified in the 1993 complaint filed against UTC and its facilities. This conclusion is supported by: (1) comparatively few repeat instances of noncompliance occurred in the 1998 audits and (2), on average, the fewer instances of noncompliance at facilities in 1998.

- The severity of noncompliance also typically decreased. For example, in 1990, two-thirds of the facilities had been cited for storing hazardous waste for more than 90 days, and five of the six facilities reviewed under the CWA had been cited for unauthorized discharges to surface water without permits. In contrast, the post-EMS surveys indicate that only one UTC facility had an unauthorized or unpermitted activity (a pretreatment discharge).

- Overall, the usefulness of information about practices at facilities (for example, elements of an EMS present) and responses to noncompliance events related to violations identified in the 1993 complaint may be limited because fewer individuals at UTC have first-hand knowledge of practices in 1990. For example, responses in the pre-EMS surveys that are related to corrective actions are the same for several facilities, because it is only known in general how violations were addressed, (that is, by implementing the EMS), but current personnel of UTC have only vague recollection of specific corrective actions in 1990.

- The general category of root cause of noncompliance identified most frequently in the post-EMS surveys was **Regulations and Permits**. Further evaluation of the specific root causes reveals that disagreement over the interpretation of regulations often is cited as the root cause of noncompliance. UTC recommended UTC and the regulatory agencies

should strive to improve communication (for example, through meetings or other communication in addition to such activities as formal inspections) because establishment of informal dialogue may build greater understanding of facility operations on the part of regulators and greater understanding of the regulators' interpretations of regulations on the part of UTC.

- On the basis of responses to the post-EMS survey, UTC should review its programs for effectiveness on employees to maintain compliance. **Human Error** and **Communication** became more prominent as root causes of noncompliance (accounting for a greater percentage of instances of noncompliance) in the post-EMS profiles, compared with the pre-EMS profiles. Modification of training programs may be a logical step in addressing those root causes of noncompliance.

- Implementing an EMS appears to have moved the root causes of noncompliance from the category of management (lack of structure, control and oversight, guidance) toward the more intractable root causes of human error and communication.

- UTC should review its process for the evaluation and implementation of procedures for complying with new regulations. Many of the instances of noncompliance identified in the post-EMS profiles were related to regulations issued by EPA or the state during the period between 1990 and 1998 (for example, stormwater regulations under the CWA). Although the post-EMS surveys generally indicate that specific personnel are assigned to monitor new regulations, the results of the 1998 audits indicate that such monitoring may not have been sufficient to ensure compliance in all cases.

- **External Circumstances** played a more prominent role as a root cause of noncompliance in the post-EMS surveys than in the pre-EMS surveys. This provides an example of how more intractable root causes may become more prevalent after EMSs have been implemented. Several of the facilities do not include communication with external entities in their EMSs. Thus the root cause of **External Circumstances** could potentially be addressed by greater involvement with external entities (for example, suppliers, customers, contractors, and vendors) under the EMS in place at each facility.

- The results of both UTC and RCA projects support EPA and state agencies continued work on issuing straightforward, plain language regulations, and continued coordination within their organization and with each other to ensure clear and consistent interpretation of those regulations. The results also support continued or increased compliance assistance activities, particularly with respect to new regulations and important new interpretations.

- It appears that the implementation of EMSs may offer the advantage of helping a facility to focus on environmental compliance issues. This statement is based on improved compliance rates at participating UTC facilities, including both (1) fewer total instances

of noncompliance at each facility, and (2) fewer facilities with individual instances of noncompliance. In addition, instances of noncompliance identified during the 1998 audits typically were much less severe than those identified during the 1990 inspections.

- Results of the survey indicate that, although UTC had begun implementing P2 activities in 1988, most of those activities were undertaken in response to environmental reporting requirements (for example, requirements for reporting releases to the Toxic Release Inventory). P2 efforts at UTC have increased markedly since 1990, aided by the increased emphasis on reporting and accountability inherent in EMS.

- The findings of this analysis suggest that in organizations that have implemented EMS (such as UTC in 1998 and CMA members covered by the RCA project), improvements in compliance are most likely to come from a combination of (1) improving and maintaining the EMS, (2) training and other means of increasing awareness of EMS elements and regulatory requirements, and (3) clearer regulations and more compliance assistance.

- As was recommended in the RCA project, this study indicates that improvements in compliance might also result from the development of a better understanding of the causes of human error and the identification of actions to address **Human Error**.